भारतीय मानक
Indian Standard

IS 6433 : 2021

गनाउटिंग उपकरण — विशिष्टि

(पहला पुनरीक्षण)

Guniting Equipments — Specification

(First Revision)

ICS 91.220

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भारतीय मानक ब्यूरो
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Construction Plant and Machinery Sectional Committee, MED 18

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Construction Plant and Machinery Sectional Committee had been approved by the Mechanical Engineering Division Council.

The guniting equipment is quite often used for specialized reinforced concrete works, such as lining of pressure mains and tunnels, resurfacing of reservoirs and river and sea walls. It is also used for repair and maintenance work, such as the restoration of reinforced concrete, exposed reinforced cement concrete and masonry structures and repair of reinforced concrete bridges.

In view of the increasing use of guniting equipment, more and more application in the field and also in view of the fact that the manufacture of guniting equipment has already been increased in the country by the manufacturers, it has been considered necessary to lay down the revised standard specifications for guniting equipment.

This standard was originally published in 1972. The major changes in this revision are:

a) Terminologies are added,
b) Construction has been modified,
c) New Clause on 'equipment requirement for handling of the material and guniting application' has been added, and
d) A new clause on 'specification for rubber sand blast hose' has been added.

The composition of the Committee responsible for the formulation of this standard is given in Annex B.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

GUNITING EQUIPMENTS — SPECIFICATION

(First Revision)

1 SCOPE

This standard lays down the requirements for sizes, dimensions and performance of concrete guniting equipment.

2 REFERENCES

The standards listed in Annex A contain provisions, which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards.

3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply.

3.1 Shotcrete — Mortar or concrete conveyed through a hose and projected at high velocity on to a surface, also known as air-blown mortar, also pneumatically applied mortar or concrete, sprayed mortar and gunned concrete.

3.2 Dry-Mix-Shotcrete — Pneumatically conveyed shotcrete in which most of the mixing water is added at the nozzle.

3.3 Gunite (Trade Name) — Method of applying dry-mix shotcrete.

3.4 Wet-Mix Shotcrete — Shotcrete wherein all ingredients, including mixing water, are mixed in the equipment before introduction into the delivery hose, it may be pneumatically conveyed or moved by displacement.

3.5 Cement Gun — Device employed in the application of cement mortar in spray form, pneumatic operation.

3.6 Pneumatic Guniting / Shotcreting Machine — Equipment consists of a twin chamber gun and a twin water tank and is powered by an air motor. The material is deposited on the desired surface through a placing nozzle under a compressed air. These machines can also be used for sandblasting work by fitting on a sand blasting nozzle.

3.7 Spray Guniting Machine — The single axle strongly built machine works on the principle of dry conveyance. The dry mix is transported from the feeding hopper through the rotors to the material exit. Different rotors are available for a variety of applications. Water is added in the spraying nozzle at the end of the hose. It is provided with about 2.2 KW (3HP) and a.c. electric motor of 440 Volt. It is supplied with 31 to 50 mm dia hoses and maximum conveying distance of about 250 m and maximum conveying height of 60 to 75 m.

3.8 Hosepipe — A flexible pipe for conveying a liquid or gas/air. A hose is generally a flexible hollow tube designed to carry fluids from one location to another. Hoses are also sometimes called pipes (the word pipe usually refers to a rigid tube).

3.9 Vessel — A container (as a cask, bottle, kettle, cup, or bowl) for holding something.

3.10 Air Motor — A device in which the pressure of confined air causes the rotation of a rotor or the movement of a piston.

3.11 Nozzle Operator — Nozzle operator means the worker on the shotcrete crew who manipulates the nozzle, controls consistency with the process and controls final placement of the material.

4 MATERIALS

4.1 All materials used in the construction of guniting equipment shall conform to the requirements of relevant Indian Standards. The guniting equipment shall consist of the following:

a) Cement gun,
b) Water tank,
c) Material hose pipe, and
d) Accessories.

4.2 Cement Gun

It shall be of two interconnecting circular vessels fixed one above the other and having airlock valves operated by hand.

4.2.1 *Air Motor*

The air motor shall be connected to the reduction gear and the capacity of the same shall be sufficient to throw material at the rate of 2 l per h at a distance of 30 m and head of 3 m.

4.3 Water Tanks

Twin cylindrical water tanks connected in parallel with arrangement for feeding water to the material hose pipe of one tank at a time shall be provided. The water tank shall be fabricated out of steel plates conforming to IS 2062 and shall be tested against a pressure of 15 kg/cm^2. Each water tank shall have an inlet water pipe at the top and a cleaning mouth at the bottom and both shall be made watertight by stoppers.

4.4 Hose Pipes

A material hose pipe of sand blasting quality of diameter 30 mm and of length 15 m with couplings at two ends shall be provided with each machine along with an air hose and a water hose of 15 m length each and diameter 20 mm and 12 mm respectively.

4.5 Accessories

Accessories shall include the following:

a) 25 mm air hose with clamps to take compressed air to the gun;
b) Two nozzle bodies complete with 25 mm internal dia tip (to suit 20 mm internal dia, rubber liner);
c) Two' nozzle tips 20 mm (to suit 12 mm inside dia rubber liner);
d) One dozen tip liners 20 mm (inside dia 12 percent mm);
e) One dozen tip liners 25 mm (inside dia 20 mm);
f) Two cone valve gaskets;
g) Two air hose couplings;
h) Two extra rubber liners for water outlet valves;
j) Three gun operating keys;
k) One socket wrench;
m) One oil can; and
n) One grease gun.

The whole equipment when assembled shall be airtight and mounted on wheels to make it mobile (*see* Fig. 1).

The top vessel shall be suitable for feeding of sand-cement mix and shall work as tank storage. The bottom vessel shall have a valve at the top and feeder at the bottom rotated by means of a worm and worm wheel drive attached to the lower part of the bottom vessel. The bottom vessel shall be fitted with a 30 mm material hose of sand blasting quality conforming to IS 5894 and IS 6416.

At the discharge end of the material hose, a nozzle made of gunmetal with arrangement for water mixing with cement-sand mix shall be provided.

4.6 Vessels

The vessels shall be made from mild steel conforming to IS 2062**.** The minimum thickness of the vessel shell shall be 5 mm. The top vessel shall be provided with a hopper on the top of a capacity of about 55 litres when filled up to heaping and shall have a disc valve closely fitting on to the rubber packing fitted to the bottom of the hopper and operated by means of a lever. The capacity of the top vessel shall be 140 litres. The bottom of the upper vessel shall fit tight on the top of the bottom vessel and fixed by means of bolts with a rubber packing in between and shall have a disc valve also firmly fitting on to the same. The valves shall be operated by levers mounted on the top and bottom vessels. The lever operation shall be done by means of handles fixed on to shafts which pass through the vessels and shall be made airtight by providing rope of lands. The bottom vessel shall be mounted on wheels so that the base of the bottom vessel is sufficiently above ground level to enable it to move and to remove it without touching the ground.

4.7 The top vessel shall be provided with the following:

a) Pressure gauge to indicate the pressure of the air in the vessel;
b) Safety valve, tested to 10.5 kg/cm^2 and capable of blowing off at 7 kg/cm^2;
c) Blow off valve;
d) Cleaning valve;
e) Air inlet valve;
f) Air connection to the air motor;
g) Moisture and oil separator; and
h) Air release.

4.8 The bottom vessel shall be provided with the following:

a) An inlet valve for the air.
b) An outlet valve for the material hose pipe which should have an airtight coupling on it.
c) A fan mounted at the bottom of the inside of the vessel which shall be operated through a reduction gear. The fitting between the reduction gear and the fan shall also be made tight against leakage of air and sand. The fan and the reduction gear shall be operated by means of an air motor so that the speed of the fan is about 10 to 15 rev/mm.
d) Hand hole for cleaning of the inside of the gun.
e) Air inlet point or the outlet point to put the material into the material hose.

4.9 All valves shall be tested to a pressure of 20 kg/cm^2.

5 PERFORMANCE REQUIREMENTS

5.1 General

The design of the delivery equipment shall be such that it shall be capable of discharging the sand-cement mixture into the delivery hose and shall deliver a continuous smooth stream of uniformly mixed material at a proper velocity to the discharge nozzle.

5.2 Discharge Nozzle

The discharge nozzle shall be equipped with a manually operated water injection system (water ring) for directing an even distribution of water through the sand-cement mixture. The water valve shall be capable of ready adjustment to vary the quantity of water, and shall be convenient to the nozzle man.

5.2.1 The nozzle shall be capable of delivering a conical discharge stream of uniform appearance throughout. Distortion of this stream or any non-uniform appearance, indicates a worn nozzle liner or mal-functioning of water injection system.

NOTE — The delivery equipment shall be thoroughly cleaned at the end of each shift. Equipment parts, especially the nozzle liner and watering, shall be regularly inspected and replaced as required.

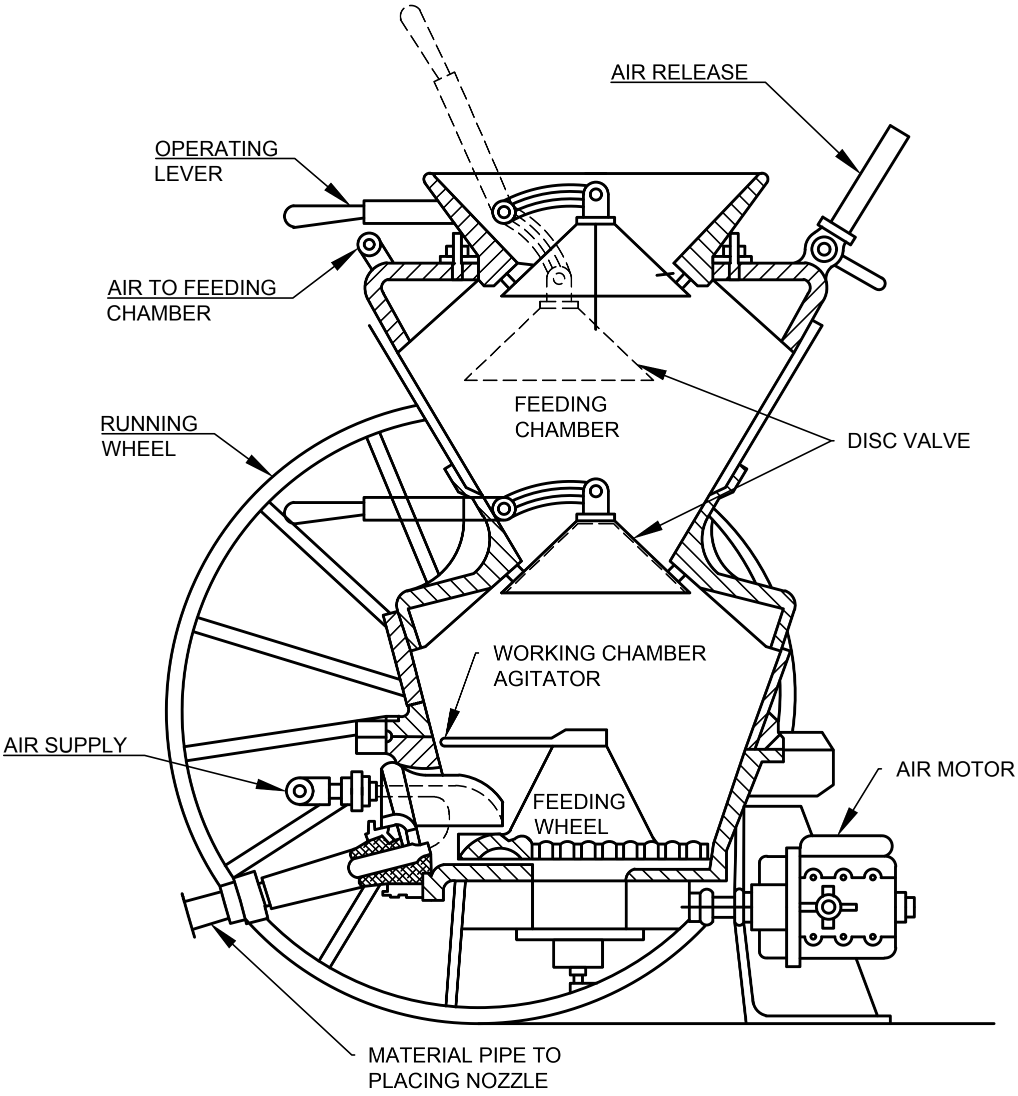

Fig. 1 General Arrangement for Gunniting Machine

6 EQUIPMENT REQUIREMENT FOR HANDLING OF THE MATERIAL AND GUNITING APPLICATION

6.1 Materials

6.1.1 *Cement*

The cement used shall be any of the following, with the prior approval of the engineer-in-charge:

a) Ordinary Portland Cement (OPC) 33 grade, 43 grade, and 53 grade conforming to IS 269;
b) Rapid hardening Portland cement conforming to IS 8041;
c) Portland slag cement conforming to IS 455;
d) Portland Pozzolana cement conforming to IS 1489;
e) *Hydrophobic cement conforming to IS 8043;
f) *Composite Cement conforming to IS 16415; and
g) *Low heat Portland cement conforming to IS 12600 .

* Cements shall be used with adequate precautions with regard to removal of formwork, etc.

6.2 Dry Mix Process

6.2.1 *Batching and Mixing Equipment*

Batching by mass is recommended. Sand and smaller size coarse aggregates shall be batched by weight and periodic checks are also made to ensure that the masses are maintained within the required tolerance. IS 4926 and IS 4925 may be followed.

The moisture content of the aggregates shall be such that the aggregate-cement mixture shall flow at a uniform rate, without segregation, through the delivery hose. The optimum moisture content will depend upon the delivery equipment being used, but it is generally within the range of 3 to 6 percent. The sand shall be moistened or dried as required to bring the moisture content to a satisfactory level. Fluctuations in moisture content shall be avoided.

The mixing equipment shall be capable of thoroughly mixing the aggregates and cement in sufficient quantity to maintain continuity of placing. The mixing time shall be not less than 1 min in a drum-type mixer, where other mixers are proposed, satisfactory evidence shall be presented that they are capable of thorough mixing. The mixer shall be self-cleaning, capable of discharging all mixed material without any carryover from one batch to the next. It shall be inspected and thoroughly cleaned at least once a day (and more often if necessary) to prevent accumulations of batched material.

6.2.1.1 *Delivery equipment or guniting equipment*

The working of delivery equipment shall comply with the application requirements given in IS 9102.

6.2.2 *Air Supply*

Properly operating air compressor of ample capacity is essential for a satisfactory shotcreting operation. The compressor shall be jetted with a moisture extractor to keep up a supply of clean, dry air adequate for maintaining a sufficient nozzle velocity for all parts of the work while simultaneously operating a blow pipe for clearing away rebound.

The operating pressure is the pressure driving the material from the delivery equipment into the hose, and is measured by a gauge near the material outlet of the gun. The air pressure shall be uniformly steady (non-pulsating).

For lengths of hose up to 30 m, air pressure at the gun shall be 0.3 N/mm^2 or more. Where the length exceeds 30 m, the pressure shall be increased by 0.035 N/mm^2 for each additional 15 m of hose required, and by 0.035 N/mm^2 for each 7.5 m that the nozzle is raised above the gun.

6.2.3 *Water Supply*

The water pressure at the discharge nozzle shall be sufficiently greater than the operating air pressure to ensure that the water is intimately mixed with the other materials. If the line water pressure is inadequate, a water pump shall be introduced into the line. The water pressure shall be uniformly steady (non-pulsating).

6.3 Wet Mix Process

6.3.1 *Batching and Mixing Equipment*

Batching by mass is recommended. Aggregates may be batched by volume if periodic checks are made to ensure that the masses are maintained within a required tolerance. Water may be batched either by mass or by volume.

The mixing equipment shall be capable of thoroughly mixing the specified materials in sufficient quantity to maintain continuous placing. The required mixing time will depend on the mix being used and the efficiency of the mixer. Delivery of concrete at the desired workability and uniformity from batch to batch is essential to a good shotcreting/guniting operation especially in vertical and overhead applications.

6.3.2 *Delivery Equipment*

The pneumatic feed type of wet mix delivery equipment is capable of applying high quality, low-slump mortar or concrete with the reliability needed for general construction and repair work. From a pressurised vessel in the equipment, the premixed materials and compressed air are discharged into the delivery hose. The material and air pass through the hose to the gunning nozzle which is fitted with an air ring for injecting additional compressed air.

The wet mix delivery equipment shall be of a design and size which, have given good results in similar work.

It shall be capable of delivering the premixed materials accurately, uniformly and continuously through the delivery hose. The size of the hose is generally within the range of 32 to 65 mm.

Recommendations of the equipment manufacturers shall be followed with regard to the type and size of nozzle to be used, and the cleaning, inspection, and maintenance of the equipment.

6.3.3 *Air-supply*

The air compressor shall be capable of keeping up a supply of clean air adequate for maintaining sufficient nozzle velocity for all parts of the work and for simultaneous operation of a blow pipe for clearing away rebound.

7 MARKING

7.1 The following information shall be permanently and conspicuously marked on the machine:

a) Manufacturer's name or trade-mark and serial number of the machine;

b) Year of manufacture;

c) Rating of the power unit; and

d) Total weight of the machine (empty and filled with materials).

7.2 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the product(s) may be marked with the Standard Mark.

8 SPECIFICATION FOR RUBBER SAND BLAST HOSE

For more details on specification for rubber sand blast hose with braided textile reinforcement, specification for rubber sand blast hose with woven textile reinforcement and specification for structural steel (standard quality) following IS may be referred:

a) IS 10660: 1983 'Rubber hydraulic hose with textile reinforcement' ;

b) IS5894: 2007 ' Rubber hose for sand blasting' ; and

c) IS 226 : 1975 ' Specification for structural steel standard quality (*fifth revision*)'.

8.1 Contractual Conditions of Shotcrete Equipment

A list of equipment and accessories to be used, including the following information, shall be submitted to the client/users at least 14 days prior to the application of shotcrete:

a) Equipment type and capacity;

b) Nozzle type and size; and

c) Continuous feed predampener details, only when the dry mix process is used.

ANENEX A

(*Clause 2*)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
2062 : 2011	Hot rolled medium and high tensile structural steel (*seventh revision*)
5894 : 2018	Rubber hose for sand and grit blasting — Specification (*third revision*)
6416 : 1988	Methods for measuring case depth of steel (*first revision*)
269 : 2015	Ordinary Portland cement — Specification (*sixth revision*)
8041 : 1990	Specification for rapid hardening Portland cement (*second revision*)
455 : 2015	Portland slag cement — Specification (*fifth revision*)
1489 (Part 1) : 2015	Portland Pozzolana cement — Specification: Part 1 Fly ash based (*fourth revision*)
1489 (Part 2) : 2015	Portland Pozzolana cement — Specification: Part 1 Calcined clay based (*fourth revision*)
8043 : 1991	Specification for hydrophobic Portland cement (*second revision*)
16415 : 2015	Composite cement Specification
12600 : 1989	Specification for low heat Portland cement
4926 : 2003	Code of practice ready-mixed concrete (*second revision*)
4925 : 2004	Concrete Batching and Mixing Plant (*first revision*)
9102 (Part 1 and 2) : 1979	Rubber blankets for shrinkage range: Part 1 Requirements for rubber blankets Part 2 Recommendations for maintenance
10660 : 1983	Rubber hydraulic hose with textile reinforcement

ANNEX B

(*Foreword*)

COMMITTEE COMPOSITION

Construction Plant and Machinery Sectional Committee, MED 18

Organization	*Representative(s)*
Ministry of Defence, CQAE, Pune	Brig P. K. Shrivastava (Chairman) Col Manjunath B. T. (*Alternate*)
AIMIL Ltd, New Delhi	Shri Rohitash Barua Shri K. K. V. Yasas (*Alternate*)
Airport Authority of India, New Delhi	Shri G. K. Choudhary Shri R. L. Sharma (*Alternate*)
Atlas Copco (India) Ltd, Pune	Shri Vijay Sharma Shri Yogesh Tuljapurkar (*Alternate*)
Ammann Apollo India Pvt Ltd, Ahmedabad	Shri D. Mashru Shri Anand Patel (*Alternate*)
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Directorate General Border Roads, New Delhi	Shri P. R. Ray
Escorts Construction Equipment Ltd, Faridabad	Shri Faiz Ahmad Shri Laxmi Chand Tyagi (*Alternate*)
In personal capacity, New Delhi	Shri Hansraj
In personal capacity, New Delhi	Shri S. N. Mahajan
In personal capacity, New Delhi	Shri Rajendra Jee
In personal capacity, New Delhi	Shri Satander Kumar
Indian Construction Equipment Manufacturers' Association, Bangalore	Shri K. V. Krishnamurthy
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